

13 November 1967

Questions and Answers - Diffusion Transfer Processing System

1a. Question - How much stop-and-go processing, permitting inspection of film, is done presently for the more sophisticated materials such as I, O and TK?

Answer - Interrupted processing by the Trenton and Yardleigh machines provides a capability for "inspecting" after a primary processing level has been completed. This inspection must be done on the fly in the dark, hence only infrared scanners and/or snooperscopes can be used. A rough estimate of the utilization of this capability is the percentage of material processed at less than full processing. This is estimated at 5 to 15% for I material, zero for O material and 5 to 25% for TK materials.

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When I or O materials are processed at [REDACTED] they are processed at a single-level (comparable to full level) on a Fultron Processor.

1b. Question - How much of a disadvantage is it not to be able to adjust processing using the proposed system?

Answer - If the film were always correctly or uniformly exposed, there would be no need at all to adjust processing. If the exposure time cannot be preprogrammed nor adjusted in-flight, then the need to change processing levels is a function of changes in sun angle, cloud cover, haze and ground reflectance. Our present thinking is that these can be compensated for by a single level process at a lower gamma and with a resultant increase in latitude of the film-process combination.

2. Question - Taking a typical O mission, how many people are presently employed in producing one O.N. and two D.P.'s at [REDACTED] as an example? In other words, what are the specific comparison personnel figures for the two systems?

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Answer - Assuming a typical O mission to be ^{two} 3,000 ^{rolls} feet of material (which could be handled in one 12-hour trick), [REDACTED] now uses 28 men in the Photo Lab, including one program monitor, two supervisors, and two maintenance men. The same job could be completed in the Diffusion Transfer System Shelter with three people in five (5) hours.

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To be fair in the comparison, however, it should be noted that the three-man shelter operation plans to take certain short cuts in comparison with the normal routine at [REDACTED]. For instance, titling is assumed to be limited to hand marking on leaders and trailers rather than frame by frame. There are no separate cleaning or waxing operations, and printing of dupes will be done on the basis of eyeball-densitometry without the laborious Dmin-Dmax measurements performed at [REDACTED].

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3. Question - Related to 2 above, assuming this new system in production, what is the best estimate on comparative costs of the two systems in equipment, film and chemicals?

Answer - We assume "in production" to mean that all equipment development work has been completed and the equipments are to be manufactured in reasonable quantities (i.e., 5 to 10 of each).

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The comparison is based on [REDACTED] which has two Fultron Processors. Furthermore, the only equipment to be compared with a Diffusion Transfer System is the processor, printer and chem mix, as all other support equipment would be common. Similarly, original and dupe film are common to both approaches. Following are ROM prices for conventional processing vs Diffusion Transfer Processing of 3,000 feet of O.N. and two dupes.

	<u>Conventional</u>	<u>Diffusion Transfer</u>
<u>Equipment</u>		
2 Fultrons, Chem Mix, 1 Niagara	\$227,500.	
3 Triepins, 1 Niagara		\$69,000.
<u>Chemicals (Per Mission)</u>		
Fill and Replenishment	\$ 600.	
Bimat, Drimat and Desimat Mat'ls.		\$ 3,500.*
<u>Water (Per Mission)</u>		
Chem Mix and Washing	2870 gals.**	
For Use with Desimat Tape		50 gals.
<u>Power</u>	80 KW***	10 KW

*Strictly ROM since prices not yet established.

**Cost of water will vary with the local situation.

***For lab equipment only.

4. Question - Does adding to the specifications the capacity for processing in-flight present any problems?

Answer - If suitable air and 10 kw of 115 volt power are available to the shelter while being transported, personnel could readily

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operate the Trispin units and the Niagara Printer, which are the only real equipment required. The efficiency of such an exercise would depend on:

- (1) Sufficient Bimat, Drimat and Desimat materials being available in the shelter before take-off.
- (2) Smoothness of aircraft flight during the processing operation.
- (3) Degree to which personnel were safeguarded from bumping or banging around in case of rough weather.
- (4) Amount of equipment, such as the engine generator, normally strapped down in the shelter aisle during transportation.

If only the quick Bimat positive were required, only the Trispin units would be needed, and all three could be pressed into service to expedite the work flow. There would be only three operations - namely, lamination of exposed negative with presoaked Bimat, delamination of same, and cover-sheeting the Bimat positive. Only one operation, the first lamination, must be in the dark. (The tacky O neg could be left wound on itself for a later opportunity to clean it up.)

In short, emergency operations could go on in the shelter during flight, although working conditions would not be ideal, and there would be some risk of personnel being bumped or banged up in rough weather.

5. Question - How much sooner can the consumer get the first positive under the new system as compared to conventional processing?

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Answer - Using [REDACTED] and 3,000 feet of I material as a basis, it would require about six hours from the start of O.N. processing until the first Dupe Positive is complete when two Fultrons are used. Using the Diffusion Transfer Shelter, the Bimat positive is available in about one hour after the start of processing and a Drimat processed dupe positive would be available in about 2.5 hours.

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6. Question - What is the estimated cost, weight and cube for chemicals to [REDACTED] for support of Black Shield?

Answer - It would be extremely difficult to estimate the total cost, weight and cube of all chemicals used to support BS due to the various sources of supply. It appears more feasible to state weight, cube and cost for the chemicals projected for a single BS mission (above):

	<u>Weight (lbs.)</u>	<u>Cu. Ft.</u>	<u>Cost</u>
Developers	350	10	\$350.

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	<u>Weight (lbs.)</u>	<u>Cu. Ft.</u>	<u>Cost</u>
Fixer	1300	30	\$220.
Hardener	150	3	\$ 30.
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Totals	1800 lbs.	43 Ft ³	\$600.

7. Question - NPIC tells me that the optimum gamma from the PI standpoint is about 2.14, with high/low limits of 2.12 and 2.17. In view of the fact that Bimat has a low gamma, can chemistry be adjusted to provide optimum gamma?

Answer - As discussed in our preliminary review at our place on 20 Sept. 1967, presently available Bimat materials are inherently low gamma materials since the emphasis to date has been on developing this system for tactical use. Bimat processing of I (3400, 3401 and 3404) and O (3404) materials with presently available Bimat films will produce O negs with lower gamma than by most other processing systems.

The attached table shows a comparison of some of the current processes for negative materials with the Bimat process. It is not clear where the stated optimum of 2.14 with limits of 2.12 and 2.17 comes from, in view of the spread of values shown; however, there is no question that the PI is accustomed to a higher contrast O neg than Bimat processing would produce. The advantages and disadvantages of this difference need to be evaluated by careful testing.

There is the possibility that in general a low-gamma process will not present to the PI as much detail in imagery of low-reflectance objects as will a higher gamma process. However, the Bimat process shows an intensification of density at the edges of dark areas. This phenomenon, in effect provides an increase in micro contrast not measurable in the macro equipment used for measuring gamma as expressed in the H&D curve. Thus subjective evaluation (by the PI) will yield more information content in the fine detail of a target area than might be predicted from the gamma value alone.

Another unique feature of the Bimat process, of course, is the Bimat positive itself. The resolution of this quick positive is not quite as high as the negative which it has processed, but it is a very high-gamma positive copy of the imagery. The value of this copy has never been assessed for high altitude material of the I and O types.

Since this is a question that really can best be answered by subjective evaluation of comparable exposed scenes developed by the two processes, it is recommended that typical exposed I material be provided at the earliest possible date for comparison processing by conventional and Bimat chemistry.

Looking to the future, if a somewhat higher gamma Bimat material appears desirable for high altitude photography, it is entirely possible, based on earlier work, that our Research Laboratories can develop Bimat

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imbibants with this characteristic. It would appear that 3400 and 3401 might be easier materials to mate with higher gamma Pmat imbibants than 3404 but this is a very preliminary engineering judgment.

8. Question - What are the possibilities of this system for TK processing?

Answer - Since 3404 film plays the major role in this area the comments under question 7 above apply here, too. Under emergency conditions, low-gamma processing of TK material would deliver usable imagery with resolution comparable to present Trenton and Yardleigh processing over most of the scene luminance range. There is however, the question which still needs to be resolved, of possible loss of some detail in the low-reflectance areas discussed under question 7.

The long range possibilities of the Diffusion Transfer System as applied to TK material, are certainly impossible to predict with any accuracy at this time.

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ATTACHMENT

BIMAT - CONVENTIONAL PROCESS COMPARISON OF O.N. MATERIALS

Interrupted Process						Bimat Systems					Comments
Film Type	Proc Cond	Log E Speed	.6 Gamma Aerial Exp Index	Base + Fog	Gamma	Log E Speed	.6 Gamma Aerial Exp Index	Base + Fog	Gamma	Imbibant Ident	
3404	Full	1.15	3.5	.22	2.27	1.26	2.75	.20	1.31	PS 485K	PS 485K does not yield a usable Dupe Positive
	Int	1.34	2.3	.13	2.47						
	Pri	1.45	1.8	.09	2.30						
3400	Full	2.32	24	.12	2.64	2.50	16	.20	1.32	MX 615	
	Int	2.60	13	.09	2.51						
	Pri	2.80	8	.06	2.35						
3401	Full	3.88	68	.12	2.46	3.92	60	.22	1.13	MX 615	
	Int	2.17	34	.08	2.39						
	Pri	2.41	19	.08	2.08						

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FLA-147-100169-2
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AO HIL NO. 67-765
TERMS AND CONDITIONS
BUDGETARY ESTIMATE
SPECIAL PROCESSING SHELTER

1. Delivery of hardware is contemplated 12 months after receipt of order. A final report will be delivered in the 15th month.
2. No effort has been included in this estimate to eliminate or reduce potential EMI generated by this equipment.
3. We assume that the type of shelter built by Forte-Kamp will be satisfactory to meet transportation and field environment requirements.
4. No program has been contemplated for testing the completed shelter assembly under various environmental conditions, under handling and transportation conditions, or for generation of EMI.
5. It is assumed all commercial product will be furnished GFE from Contract PP-15CO.
6. It is assumed that this program will be carried out on a GPOF contract.
7. An allowance is included for furnishing two (2) copies of a commercial type operating instruction manual and a thirty (30) day supply of expendable spare parts to be supplied concurrently with the shelter.
8. Final acceptance will be at the contractor's facility.
9. Shipment will be made F.O.B. Contractor's loading dock.
10. Our budgetary figure includes no allowance for field services or personnel training.
11. No allowance has been made in this estimate for space allocation or re-arrangement to handle the final assembly and testing of the completed shelter system.

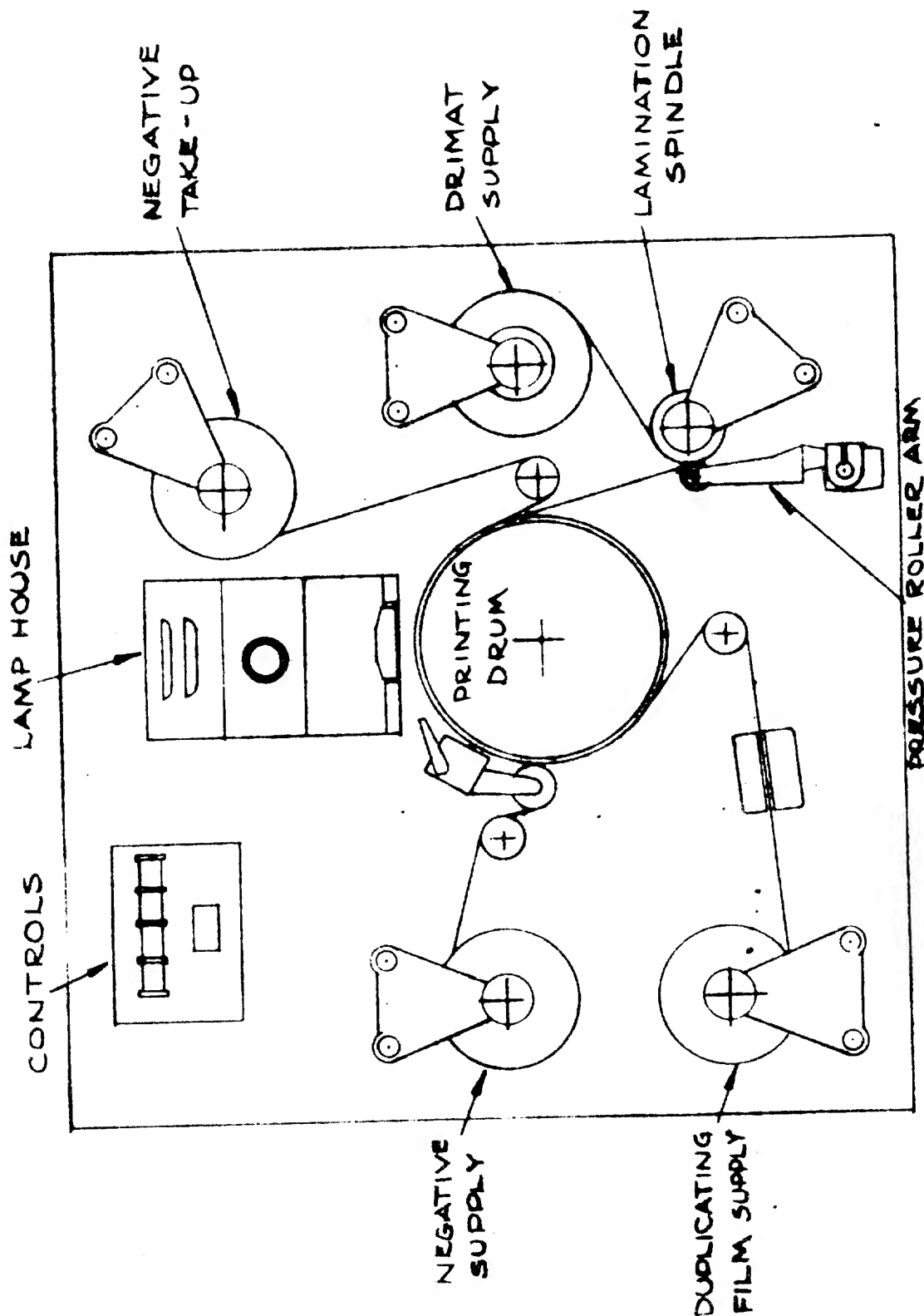
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**AO BID NO. 67-765
BUDGETARY ESTIMATE
SPECIAL PROCESSING SHELTER**

	<i>Rom</i> <u>Price</u>
1. Program Direction and Control	\$ 39,900
2. Tri Spin Units - Qty. 3 (Shock Mounted)	182,700
3. Niagara - Qty. 1 (Shock Mounted)	47,800
4. Viewing and Splicing Stations - Qty. 2	71,100
5. Film Spool Dollies - Qty. 2	6,400
6. Porta-Kamp Shelter - equipped with furniture	59,800
7. Misc. Laboratory Equipment and Tools	19,000
8. PAK Kit and Supplies for Shelter	5,900
9. Final Assembly of Equipped Shelter	15,800
10. Reefers Equipped with Storage Racks - Qty. 2	59,200
11. Systems Engineering and Drafting	309,000
12. Engineering Modification and Checkout	46,900
13. PITA Checkout	30,600
14. Systems Manual	29,600
15. Reports - Monthly and Final	12,400
16. Auxiliary Power Unit	<u>5,300</u>
TOTAL	\$941,400

JMG/TIB:dec
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PROPOSED DRIAGARA PRINTER/PROCESSOR

Packaging of film and transport to Rochester | Conventional processing at EK | Transport to NPIC | Prelim. Photo Interp. Report Published | 52 hours, spot reports in 40 hours +

Packaging and transport to [redacted] | Conventional processing at [redacted] | Prelim Photo Interp Report Published | 34.5 hours, spot reports in 13 hours plus

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MSN
RECOVERED
AND
Film Offloaded

conventional ^{act} processing on recovery site or near | Preliminary Photo Interp. Report Pub. | 27.5 hours, spot reports 6 hours plus

Proposed ^{Penta-spin} Processing at recovery site | Preliminary Photo Interp. Report. Pub. | 24 hours, spot reports 2.5 hrs +

1. Statement of target requirement
2. Transmission of #1 to aerial reconnaissance unit.
3. Flight planning
4. Actual mission time
5. Unloading film from aircraft { conventional processing + duplicating
packaging in preparation for transport
6. Transportation time.
7. Time of receipt by processor, unpackaging, processing, delivery to P.I.
8. P.I. report.